Thrombo-embolism of the subclavian artery

A case report

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Summary

Acute thrombo-embolic occlusions of the subclavian artery account for less than 1% of all acute arterial occlusions of the extremities. One such case is presented and the management discussed with special reference to the technique of embolectomy and the treatment of the reperfusion syndrome with either fasciotomy or mannitol. The question of anti-coagulation is also examined.

S Afr Med J 1985; **67**: 428-429.

Patients with acute embolic occlusions of the arterial tree are not restricted geographically to centres where major vascular surgery is performed; certainly most practising medical doctors can anticipate seeing a few such cases during their careers. The subsequent quality of life of the patient depends to a large degree on the immediate and definitive management of his attendant physician.

Excluding the post-traumatic vascular occlusions, 35% of acute arterial embolic occlusions involve the limbs; of these 15% involve the upper limbs.[1,2] The subclavian artery is rarely the site of such an occlusion;[2] we draw attention to the fact that acute embolic occlusions may indeed involve the upper limbs — with catastrophic results for the patient.

Case report

A 75-year-old white man was referred to Tygerberg Hospital with evidence of acute arterial occlusion of the left arm of uncertain duration. He had atrial fibrillation and ischaemic heart disease and had had two previous cerebrovascular embolic incidents which had resulted in hemiplegia; consequently very little communication with the patient was possible.

The patient had no pain in the affected limb. The arm was cold and pale with an area of skin overlying the thenar eminence and palm having a fixed blue discoloration. No pulses were present in the axilla or arm. The hand and fingers felt 'empty' on compression, tissue turgor being greatly diminished. There were contractures of the 3rd, 4th and 5th fingers. No active movement of the hand was possible although the arm and elbow were moved freely. No sensation could be elicited in the hand.

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Although the hand appeared non-viable, the muscles of the forearm were soft on palpation and no swelling was evident. The muscle compartment pressures were, however, not determined. It was uncertain whether the finger contractures were a recent development or had preceded the incident. The absence of arterial blood supply to the arm was confirmed by emergency Doppler flow studies, which showed an occlusion of the subclavian artery and distal vessels.

The patient was immediately taken to theatre and the brachial artery was explored under local anaesthesia at the level of the midshaft of the humerus. A transvese arteriotomy was performed and a fresh, well-formed clot was extracted from the vessel. A No. 3 Shiley catheter was used to perform a distal and proximal embolectomy. From 30 cm proximal to the arteriotomy a long thrombo-embolus was removed followed by a gush of blood. After the arteriotomy had been sutured, the brachial and radial pulses were immediately reconstituted. A fasciotomy was not performed. There was no immediate clinical improvement in the condition of the hand.

When the hand was carefully reassessed 12 hours later, it was quite obvious that it was non-viable. The tissue turgor had remained unchanged and the area of skin discoloration had extended to involve most of the hand. The brachial and radial pulses were again absent although a clear pulse was present just above the elbow. In addition, an overt reperfusion syndrome of the forearm had developed. The general condition of the patient remained poor and so an above-elbow amputation was performed.

Discussion

Acute arterial occlusions involve the limbs in about 35% of cases;[1,2] of these, 85% involve the lower limbs and 15% the upper limbs. The subclavian artery is very rarely the site of an acute embolic occlusion, constituting only 4% of upper-limb occlusions, or less than 1% of all occlusions involving the limbs.[2] The left subclavian artery is involved in 85% of cases.[3]

The brachial artery is by far the commonest site of occlusion in the arm, accounting for 64% of occlusions in Wirsung *et al.*'s series.[2] This is easily accessible to the surgeon; at the level of the the midshaft of the humerus the brachial artery can be exposed under local anaesthesia through a 4 cm longitudinal incision over the artery. To gain control, tapes are placed around the vessel proximal and distal to the intended site of arteriotomy. A No. 3 Shiley catheter or equivalent Fogarty catheter is inserted and passed distally, after which the balloon is inflated to the specified volume and the catheter gently withdrawn. This procedure should be repeated until free bleeding is achieved. The catheter is then passed proximally in the same fashion. The arteriotomy is sutured with a 6/0 suture using interrupted stitches. If the embolectomy is adequate the distal pulses should be reconstituted. The pulses gradually improve in amplitude as the concomitant arterial spasm abates. A few aspects relating to embolectomies bear special mention: (*i*) anticoagulation; (*ii*) intra-operative angiography; (*iii*) the

use of mannitol; (*iv*) fasciotomy; and (*v*) regular careful re-assessment.

The role of heparinization in acute embolic occlusions is directed primarily at the underlying disease process since hospital mortality seems generally related to recurrent thrombo-embolic incidents. Hammarsten *et al.*[1] showed that adequate heparinization reduced hospital mortality in patients with acute arterial occlusions from 26% to 7%, but did not influence the incidence of good results. In fact, the incidence of local complications in that group of patients adequately treated with heparin was significantly higher than in the control group, as was the amputation rate (21% as opposed to 11%). It could, however, be argued that those patients who would have died now came to amputation. Heparinization has also been advocated as an alternative to embolectomy by Blaisdell *et al.*;[4] in support of this they report a 7% mortality rate and a 26% amputation rate, results quite comparable with those of Hammarsten *et al.*,[1] whose patients had the benefit of both heparin and surgery. Heparinization was considered adequate if the minimum 24-hour dosage of heparin was 20 000 IU or more, administered as a continuous intravenous infusion.[1]

Intra-operative angiography was not considered for our patient since the reconstitution of the radial pulse was thought to indicate distal perfusion. Recent literature, however, favours the almost routine use of angiography to assess the distal vascular tree, particularly in the lower limb.[5] If distal occlusions are present, which cannot be cleared by means of the balloon catheter, then the surgeon should expose the area of occlusion surgically and an arterioplasty should be performed at the same time as the embolectomy.[6] Jarret *et al.*[6] only needed to do this in 8% of the cases they reported. Other authors have made more frequent use of this direct arterial approach.[7] The presence of good back-bleeding does not necessarily imply a patent distal vasculature.[5]

Immediate versus delayed fasciotomy after embolectomy has been a sorely debated issue; Blaisdell *et al.*[4] in discussing Rollins *et al.*'s[8] article claimed that it was only rarely necessary in the reperfusion 'compartment' syndromes, and that denuding the muscle of its skin covering exposed the underlying tissue to a greatly increased risk of infection. The conservative attitude to post-embolectomy fasciotomy has been supported by many recent authors;[2,5,6,9] Thompson *et al.*[10] advocate fasciotomy only in cases of extreme swelling.

However, despite these views the majority opinion currently seems to be that fasciotomy should always accompany embolectomy, except where the occlusion is of less than 6 hours' duration, as long as there are adequate facilities for monitoring the patient.[11] On the basis of these criteria, our patient should have undergone fasciotomy at the initial surgical intervention.

The reperfusion or revascularization syndrome which follows embolectomy results from the loss of integrity of the vascular membrane after prolonged periods of ischaemia in addition to the oedema associated with the ischaemic and necrotic muscle in the compartment. Recently Hutton *et al.*[12] successfully used mannitol in the management of the reperfusion syndrome. This may in future replace fasciotomy.

Lastly, the regular, careful reassessment of the limb and the general condition of the patient is critical; not only is early detection of the reperfusion syndrome or re-embolization of the limb vital to its outcome, but maintenance of a good urine output is also important, since myoglobinuria may be severe after fasciotomy in the reperfusion syndrome, even precipitating acute renal failure.[11] This complication may be minimized by maintaining a high-volume alkaline urine output.

Conclusion

Despite the relatively good collateral circulation of the arm, acute embolic occlusions may threaten the viability of the limb. Therefore, if there are facilities for surgery an embolectomy should be performed as an emergency procedure. The patient should be heparinized at least postoperatively and anticoagulation therapy should be continued as long as the predisposition to recurrent embolism exists. The intracompartmental pressures should be monitored and if there is evidence of raised pressure either manometrically (i.e. pressures greater than 50 mmHg) or clinically, the pressure should be reduced in the most expedient manner; if for any reason fasciotomy cannot be undertaken immediately, a mannitol infusion should be started.

If embolectomy is not possible the patient should be fully heparinized. The affected limb should be nursed in the neutral position, i.e. at the level of the chest, particularly if oedema is already present, since elevation of the limb has been shown to aggravate the reperfusion syndrome.[11]

There is no time restriction on the performance of an embolectomy — if there is even a slim chance that a limb may still be viable, that is if there is not yet 'stiffness' of the muscles on stretching, an embolectomy should be attempted. Embolectomies have often been performed 2 weeks after an acute incident, with a limb salvage rate of 50% or more.[5–7]

The authors wish sincerely to thank Miss H. Weymar of the Cardiac Unit, Tygerberg Hospital, for the preparation of the manuscript. We also thank Dr J. P. van der Westhuyzen, Chief Medical Superintendent of Tygerberg Hospital, for permission to publish.

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